REMARKS

Claims 25-26, 28, 33-36, and 42-45 are pending in the present application. In the Office Action dated July 13, 2007, claims 42-45 were rejected under 35 U.S.C. § 112, ¶ 2, as being indefinite for failing to particularly point out and distinctly claim the subject matter regarded as the invention. Claims 33-36, 42, 44 and 45 were rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 6,177,331 to Koga ("Koga"). Claims 25-26, 28 and 43, insofar as being in compliance with 35 U.S.C. § 112, were rejected under 35 U.S.C. § 102(a) as being unpatentable over Koga in view of U.S. Patent No. 6,146,970 to Witek et al. ("Witek") and/or U.S. Patent Publication No. 2001/0030367 to Noguchi et al. ("Noguchi").

Discussion of the Disclosed Embodiment

The disclosed embodiments of the invention will now be discussed in comparison to the prior art. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the prior art subject matter, do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

Embodiments of the present invention are directed to a semiconductor structure for facilitating the deposition of materials in trenches without the formation of voids in the deposited material.

In one method, a mask layer is formed on a silicon nitride layer. The silicon nitride layer is formed in a substrate, such as silicon, with a pad layer positioned between the silicon nitride layer and the substrate. The pad layer is interposed between the silicon nitride layer and the substrate and protects the substrate from damage.

The method uses the mask layer formed on a silicon nitride layer for the formation of a faceted opening through the silicon nitride layer. That is, the silicon nitride layer is subject to an isotropic etch such that the opening through the silicon nitride layer is tapered and undercuts the mask layer. The mask layer is typically formed from a silicon oxide material. A trench is etched through the pad layer and the substrate. The mask layer is removed, leaving the silicon nitride layer to provide a faceted opening for the trench formed in the substrate. In one embodiment, the faceted opening through the silicon nitride layer reduces the likelihood that during the deposition of an insulating material, such as a silicon oxide material, into the trench, a

void will be formed. Similarly, the faceted opening through the silicon nitride layer can be used for the same purpose when forming a conductive layer filling the trench.

Discussion of the Cited Reference

The Koga patent discloses a method of forming a semiconductor device involving etching a silicon nitride film 106 formed on a silicon dioxide film 105 to expose the silicon dioxide film 105. A wet isotropic etching technique is used to form an opening through the silicon dioxide film 105 that undercuts the silicon nitride film 106. Trenches in the underlying substrate are formed through the openings in the silicon nitride film 106 and the silicon dioxide film 105. The silicon nitride film 106 is then removed by wet etching so that a thick layer of silicon dioxide film 112 can be deposited into the trenches. The thick layer of silicon dioxide film 112 and the silicon dioxide film 105 are polished back, and finally wet etched to leave some of the silicon dioxide film 112 in the trenches.

Koga is substantially different from the disclosed embodiment. For example, the Koga patent fails to disclose a layer of silicon oxide material formed on a layer of silicon nitride material. Koga in particular fails to teach a pad layer disposed between the silicon nitride layer and a substrate. In contrast, the Koga patent teaches forming a tapered opening in a silicon dioxide layer formed *directly* onto a substrate with no intervening layer to protect the substrate. Furthermore, as noted by the examiner, Koga teaches a silicon nitride layer formed on a silicon oxide layer, rather than a silicon oxide layer formed on a silicon nitride layer as disclosed by Applicants.

Witek and Noguchi fail to remedy the deficiencies of Koga. In particular it is not apparent from Witek or Noguchi why or how the silicon nitride layer and silicon oxide layers could be exchanged. Witek and Noguchi further fail to disclose the pad layer.

Discussion of the Claims

Turning now to the claims, the differences between the cited references and the claimed invention will be more particularly pointed out.

With respect to claim 25, Koga, Witek, and Noguchi, fail to teach or suggest, whether alone or in combination, all of the limitations of the claim, including "a layer of a *silicon nitride formed over the substrate and having a tapered opening therethrough* over the trench, the tapered opening having a first dimension on a first surface of the silicon nitride layer adjacent to

the trench less than a second dimension on a second surface of the silicon nitride layer opposite the first surface of the silicon nitride layer, the first dimension being substantially equal a width of the trench proximate the first surface; *a pad layer disposed between the substrate and the silicon nitride layer*; and a mask layer formed over the silicon nitride layer, the mask layer having *an opening therethrough positioned over the tapered opening and having a dimension less than the second dimension of the tapered opening of the silicon nitride layer*." As noted above, none of the cited references teach a substrate having the pad layer, silicon nitride layer, and mask layer, as recited in the claim. In particular Koga fails to teach a pad layer interposed between the silicon nitride layer and a substrate and fails to teach a nitride layer having "an tapered opening therethrough." Koga rather teaches a tapered opening formed in a silicon oxide layer formed directly on a substrate.

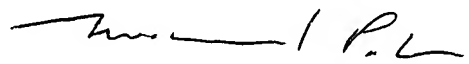
With respect to claim 33, Koga, Witek, and Noguchi, fail to teach or suggest, whether alone or in combination, all of the limitations of the claim, including "a trench formed in a substrate; *a first layer of a silicon nitride material formed over the substrate* and having a lower surface proximate to the substrate and an upper surface opposite of the lower surface, and further having an opening therethrough over the trench, *the opening having a first dimension along the lower surface and a second dimension along the upper surface greater than the first dimension*, the first dimension being substantially equal a width of the trench proximate the lower surface; *a pad layer disposed between the substrate and the first layer of silicon nitride material*; and an insulating layer formed over the first layer of silicon nitride material and extending into the opening and the trench.

With respect to claim 42, Koga, Witek, and Noguchi, fail to teach or suggest, whether alone or in combination, all of the limitations of the claim, including "a trench formed in a substrate; a first layer of insulating material formed over the substrate and having a tapered opening therethrough over the trench, the tapered opening having a first dimension on a first side adjacent the trench less than a second dimension on a second side of the first insulating layer opposite the first side; *a pad layer disposed between the first layer of insulating material and the substrate*; and a second layer of insulating material is formed over the first insulating layer and extending into the opening and the trench."

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a timely Notice of Allowance are earnestly solicited.

Respectfully submitted,

DORSEY & WHITNEY LLP



Michael G. Pate
Registration No. 53,439
Telephone No. (206) 903-2398

MGP:sp

Enclosures:
Postcard
Fee Transmittal Sheet (+ copy)

DORSEY & WHITNEY LLP
1420 Fifth Avenue, Suite 3400
Seattle, WA 98101-4010
(206) 903-8800 (telephone)
(206) 903-8820 (fax)

h:\ip\clients\micron technology\1000\501085.02\501085.02 amend af 071307.doc